IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application No.:	10/535,501
Applicant:	Lian-Ming SUN, et al.
Filed Internationally:	November 14, 2003
US National:	May 18, 2005
Title:	Method of Producing Synthesis Gas
TC/A.U.:	1793
Examiner:	Melissa A. Stalder
Docket No.:	Serie 6022
Customer No.:	000040582

APPEAL BRIEF

MAIL STOP APPEAL BRIEF - PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Applicant submits this Appeal Brief to the Board of Patent Appeals and Interferences on appeal from the decision of the Examiner of Group Art Unit 1793 dated February 11, 2009, finally rejecting claims 27 and 29-45. The final rejection of claims 27 and 29-45 is appealed. This Appeal Brief is believed to be timely since it is EFS-Web transmitted by the due date of May 12, 2009 as set by the mailing of a Notice of Appeal on March 12, 2009. Please charge the fee of **$540.00** for filing this brief to Deposit Account No. 01-1375, Attorney Docket No. Serie 6022.

The Commissioner is hereby authorized to charge any appropriate fees under 37 C.F.R. §§ 1.16, 1.17 and 1.21 that may be required by this paper and to credit any overpayment to Deposit Account No. 01-1375. This paper is submitted in duplicate.

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Real Party in Interest

The present application has been assigned to L'Air Liquide, Société Anonyme à Directoire et Conseil de Surveillance pour l'Etude et l'Exploitation des Procédés Georges Claude, Paris, France. No other entity has an interest in the present application or appeal.

Related Appeals and Interferences

Applicant asserts that no other appeals or interferences are known to the Applicant, the Applicant's legal representative, or assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

Status of Claims

Claims 27 and 29 - 45 are pending in the application. Claims 1 - 26 were originally presented in the application and were cancelled with a preliminary amendment. Claims 27 - 61 were added in a preliminary amendment. Claims 28 and 46 - 61 were cancelled during prosecution. Claims 27 and 29 – 45 stand finally rejected as discussed below. The final rejection of claims 27 and 29 – 45 are appealed. The pending claims are shown in the attached Claims Appendix.

Status of Amendments

All claim amendments have been entered by the Examiner. No amendments were proposed after the final rejection.

Summary of Claimed Subject Matter

This invention relates to a method directed to producing synthesis gas by in a catalytic ceramic membrane reactor (RCMC) *See Application*, page 4, lines 3 – 18.

A. Claim 27 – INDEPENDENT

Claim 27 recites a method which may be used for producing a synthesis gas containing hydrogen and carbon monoxide. *See Application*, page 4, lines 3 - 5. As claimed, this method includes pre-reforming a hydrocarbon mixture to obtain a first mixture. *See Application*, page 4, lines 6 - 7. As claimed, this method includes reforming said first mixture with an oxidizing mixture to obtain a raw synthesis gas. *See Application*, page 4, lines 8 - 11. As claimed, the method requires that said oxidizing mixture comprises oxygen and is heated, prior to said reforming, to a temperature of about 1000° C. *See Application*, page 4, lines 16 - 18. As claimed, the method requires that said raw synthesis gas comprises hydrogen, carbon monoxide, carbon dioxide, water, and an oxygen-depleted mixture. *See Application*, page 4, lines 11 - 13. As claimed, the method requires that said reforming is performed in a catalytic ceramic membrane reactor (RCMC). *See Application*, page 4, lines 8 - 9.

B. Claim 29 - DEPENDENT

Claim 29 further limits claim 27. Specifically, claim 29 specifies that the first mixture is brought to a temperature, prior to said reforming, at least about 111° C lower than said temperature of said oxidizing mixture. *See Application*, page 4, lines 23 - 25.

C. Claim 30 - DEPENDENT

Claim 30 further limits claim 27. Specifically, claim 30 further requires desulfurizing said hydrocarbon mixture prior to said pre-reforming. *See Application*, page 4, lines 33 - 34.

D. Claim 31 - DEPENDENT

Claim 31 further limits claim 30. Specifically, claim 31 requires that said hydrocarbon mixture is desufurized at a temperature between about 250° C and about 450° C. *See Application*, page 4, lines 35 - 37.

E. Claim 32 - DEPENDENT

Claim 32 further limits claim 31. Specifically, claim 32 further requires adding hydrogen to said hydrocarbon mixture prior to said desulfurization. *See Application*, page 4, lines 35 - 37.

F. Claim 33 - DEPENDENT

Claim 33 further limits claim 31. Specifically, claim 33 requires that said temperature of said hydrocarbon mixture is about 400° C. *See Application*, page 4, lines 35 - 38.

G. Claim 34 - DEPENDENT

Claim 34 further limits claim 27. Specifically, claim 34 requires that said pre-reforming is preformed in a catalytic reactor at a temperature between about 450° C and about 550° C. *See Application*, page 5, lines 1 - 2.

H. Claim 35 - DEPENDENT

Claim 35 further limits claim 34. Specifically, claim 35 requires that the catalytic reactor is an adiabatic type catalytic reactor. *See Application*, page 5, lines 2 - 3.

I. Claim 36 - DEPENDENT

Claim 36 further limits claim 34. Specifically, claim 36 requires that said hydrocarbon mixture is preheated, prior to said pre-reforming, to a temperature of about 500 ° C. *See Application*, page 5, lines 4 - 5.

J. Claim 37 - DEPENDENT

Claim 37 further limits claim 27. Specifically, claim 37 requires that the temperature of said oxygen-depleted mixture is lower than said temperature of said oxidizing mixture. *See Application*, page 5, lines 11 - 13.

K. Claim 38 - DEPENDENT

Claim 38 further limits claim 37. Specifically, claim 38 requires that the difference between said temperature of said oxygen-depleted mixture and said temperature of said oxidizing mixture is at least about 75° C. *See Application*, page 5, lines 13 - 14.

L. Claim 39 - DEPENDENT

Claim 39 further limits claim 27. Specifically, claim 39 requires that the temperature of said first mixture is between about 550° C and about 760° C. *See Application*, page 5, lines 26 - 27.

M. Claim 40 - DEPENDENT

Claim 40 further limits claim 39. Specifically, claim 40 requires that the temperature of said first mixture is about 650° C. *See Application*, page 5, lines 27 - 28.

N. Claim 41 - DEPENDENT

Claim 41 further limits claim 27. Specifically, claim 41 requires that said raw synthesis gas is at a temperature between about 800° C and about 1100° C; and the temperature of said oxygen-depleted mixture is lower than said temperature of said synthesis gas. *See Application*, page 5, lines 29 - 32.

O. Claim 42 - DEPENDENT

Claim 42 further limits claim 27. Specifically, claim 42 further requires the cooling of said raw synthesis gas and the separating of said raw synthesis gas. *See Application*, page 5, lines 33 - 35.

P. Claim 43 - DEPENDENT

Claim 43 further limits claim 42. Specifically, claim 43 further requires purifying said raw synthesis gas. *See Application*, page 5, lines 33 - 35.

Q. Claim 44 - DEPENDENT

Claim 44 further limits claim 42. Specifically, claim 43 further requires treating said raw synthesis gas. *See Application*, page 5, lines 33 - 35.

R. Claim 45 - DEPENDENT

Claim 45 further limits claim 27. Specifically, claim 45 requires that said oxidizing mixture is obtained through the treatment of a first oxygenated gas mixture and said first oxygenated gas mixture comprises between about 10 molar % and about 50 molar % of oxygen. *See Application*, page 6, lines 13 - 15.

Grounds of Rejection to be Reviewed on Appeal

1. Claims 27 and 29 - 45 stand rejected under 35 U.S.C. § 103 (a) as being unpatentable over Nataraj (US 6,048,472).

Arguments

Claims 27 and 29 - 45 are not unpatentable over Nataraj '472.

The Applicable Law

"Under §103, the scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved. Against this background the obviousness or nonobvi-
ousness of the subject matter is determined. Such secondary considerations as commercial success, long felt but unsolved needs, failure of others, etc., might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented." KSR Intl. Co. v Teleflex Inc, 550 U.S. 398 (2007), citing Graham v John Deere, 383 U.S. 1 (1966)

The Examiner notes that Nataraj does not teach the temperature range of between 871° and 1300° C for the oxidizing mixture prior to the reforming step. The Examiner then notes that "Nataraj discloses heating oxygen-containing gases by direct combustion with a fuel gas" and that this temperature falls within the range. Applicants would like to respectfully point out that explicitly points out that:

"Heated oxidant **41** and heated partially reformed intermediate gas **25** are introduced into respective oxidant and reactant inlets to mixed conducting membrane reactor **43**. Heated oxidant **41** is at a temperature preferably within .±200° F of the temperature of heated partially reformed intermediate gas **25** at the inlet to mixed conducting membrane reactor **43**. The gas temperature at the reactant inlet is in the range of about 1100 to 1400° F. (594 to 760° C)." (*column 12, lines 53 – 60*)

Hence, according to the teaching of Nataraj, the heated oxidant stream 41 should be no hotter than 871 °C (i.e. 760° C + 111° C), and hence neither teaches nor suggests the 1000° C temperature required by claim 27 as currently amended.

As discussed above, Nataraj '472 fails to teach or suggest all the features present in claim 27 as currently amended, upon which claims 28 – 40 and 42 - 45 are dependent. Hence this rejection, as pertains to claim 27, and claims 28 – 40 and 42 - 45 which are

dependent upon claim 27, is moot and should be withdrawn. Claims 46 and 47 have been cancelled, thereby rendering this rejection moot as pertains to these claims.

In the Response to Arguments in the Final Office Action, the Examiner finds the Applicant's previous responses, which are essentially repeated above, to be unpersuasive for three reasons. Applicants respectfully disagree with the Examiner on all three of these justifications, as explained in the following.

- First, the Examiner notes that the clause "about 1000° C" in claim 27 is a broad limitation and can include the temperature suggested by Nataraj.

Applicants respectfully point out that the term 'about' as used to modify a number or range in a claim, as discussed by the Federal Circuit, may be interpreted to encompass the range of experimental error that occurs in any measurement" *(BJ Services Co. v Halliburton Energy Services, 338 F.3d 1368 (Fed. Cir. 2003)*). While this particular possible measurement error was not discussed in the instant specification, one skilled in the art of syngas production and plant design would recognize that temperature sensors of this type typically have an accuracy of greater than +2.5%, with high quality sensors such as optical pyrometers often exceeding $\pm$0.5% in accuracy. As discussed below, it is clearly disclosed in Nataraj that the maximum reactor inlet temperature (and hence the maximum oxidant temperature) that is suitable for the disclosed mixed conducting membrane reactor design is 760 C. In order for a temperature of 760 C to be "about 1000 C", the insinuated instrument error would have to be on the order of $\pm$25%, which one skilled in the art would clearly recognize as excessive and unrealistic. Applicants respectfully argue that 760 C is not "about 1000 C".

- Second, the Examiner notes that "Nataraj does not teach that 760 C $\pm$ 200 F is the only inlet temperature that is a preferable temperature in the method and does not exclude the use of higher temperatures." The Examiner further notes that "Nataraj only discloses that this is the temperature of the oxidant at the inlet to the reactor but this does not preclude that the oxidant could be heated to a higher temperature prior to being at the preferable inlet temperature."

Applicants respectfully point out that Nataraj does not "teach that 760 C $\pm$ 200 F" is the inlet temperature at all. Nataraj teaches that 760 C is the *maximum* inlet temperature for this particular design of mixed conducting membrane reactor. It is very clearly stated in Nataraj that:

"the combined stream **21** can be further heated if necessary in heat exchanger **23** in heat exchange zone **8** to yield heated partially reformed intermediate gas **25** at 1100 to 1400 F (594 to 760 C)." (*column 12, lines 5 – 8*).

This temperature cannot be increased, per this particular disclosed process, since the:

"partially reformed intermediate gas **17** (*presumably intended to be stream* **25**) is typically within a 50 F temperature approach to reforming and shift-equilibrium." (*column 12, lines 8 – 10*).

Also, it is clearly stated that:

"Heated oxidant **41** and heated partially reformed intermediate gas **25** are introduced into respective oxidant and reactant inlets to mixed conducting membrane reactor **43**. Heated oxidant **41** is at a temperature preferably within ± 200 F of the temperature of the heated partially reformed intermediate gas **25** at the inlet to mixed conducting membrane reactor **43.** The gas temperature at the reactant inlet is in the range of about 1100 to 1400 F (594 to 760 C)."

In the Response to Request for Reconsideration in the Advisory Action, the Examiner states:

"Applicant's amended claim 27 states a temperature of about 1000 degrees Celsius. Applicant argues that this temperature is not obvious over the prior art which teaches a preferable temperature of 871 degrees Celsius. Applicant's argument is without merit because the prior art does not teach a maximum of 871 degrees Celsius. Applicant's has not established that the prior art teaches away from the oxidant being heated prior to reforming (which can be at any stage prior to reforming) to a temperature of about 1000 degrees C, as claimed. Further, applicant claims "about 1000 degrees C" and in the specification discloses a range of between 871 and 1100 degrees Celsius (pg. 8, lines 6 – 8). Therefore, Applicant cannot make the argument that 871 degrees Celsius is not "about 1000 degrees" as this is the range disclosed in applicants specification. There is nothing in the specification regarding temperature sensors and their accuracy as argued to define 'about 1000 C.""

.Applicants respectfully disagree with the Examiner, as explained in the following, taken point by point.

As discussed in detail above, Nataraj '472 clearly teaches that the heated oxidant stream 41 should be no hotter than 871 °C (i.e. 760 ° C + 111 ° C). Applicants are puzzled by how the Examiner can state that "the prior art does not teach a maximum of 871 degrees Celsius."

Applicants note that the instant specification states that "the oxidizing mixture is heated to a temperature between 871° C and 1300° C, and preferably to a temperature of about 1000° C." (page 4, lines 16 – 18). Under well established rules of Claim Differentiation, it is assumed that two claims in the same patent will not have the identical scope, but instead, that there is likely an intended difference in scope between the two. This is obviously the case where a broad range (such as 871° C and 1300° C) is first provided, with the hope that it fails to interfere with cited art; then a narrower range (such as about 1000° C) is also cited in order to circumvent any cited art. This a basic tenant of patent prosecution, and Applicants respectfully disagree that this implies that the narrower range is essentially identical as the broader range.

And finally, a comment about the reference to temperature sensor accuracy. Applicants admit that this is not explicitly referenced in the instant specification. However, MPEP Section 2111 states that "pending claims must be given their broadest reasonable interpretation consistent with the specification." In *In re Am. Acad. of Sci. Tech. Ctr., 367 F.3d 1359 (Fed. Cir. 2004)*, the Federal Circuit stated that this broadest reasonable construction must be made "in light of the specification as it would be interpreted by one of ordinary skill in the art." The Examiners interpretation of "about 1000° C" would require an error band, or an instrument error, of ± about 129 ° C, for a maximum stated temperature in Nataraj '472 of 871 ° C to be 'about' 1000 ° C. Such an instrument that would measure a true temperature of 871 ° C and lead the technician or plant operator to believe that the temperature was 1000 ° C would be dangerous, unreliable, and unacceptable in the modern world of syngas production. Applicants were simply pointing out that to one of ordinary skill in the art of syngas production, a temperature sensor accuracy of no less than ±2.5% would be acceptable, and not the ±15% that the Examiner apparently proposes.

Hence, the skilled artisan reading Nataraj would recognize that the maximum temperature of *either gas* entering the membrane reactor is limited to 1400 F (760C) and thus the oxidant cannot be higher. One skilled in the art would recognize that the intent of this disclosure is that the oxidant be cooler than the *partially reformed* intermediate gas, and be within 200 F cooler not hotter, otherwise the inlet gas temperature would exceed that specified. The skilled artisan would also recognize that there would be no incentive to heat

the oxidant stream to a higher temperature, then cool it down in order to not exceed the 760 C maximum reactor inlet temperature. This is neither taught nor suggested in Nataraj.

Conclusion

In view of the above, it is believed that the Examiner's Final Rejection of the pending claims was not warranted and must therefore be REVERSED, together with a finding that the pending claims presented with this appeal are patentable.

Respectfully submitted,

Date: **May 11, 2009**

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Claims Appendix

Claims 1 – 26 (cancelled).

Claim 27 (previously presented): A method which may be used for producing a synthesis gas containing hydrogen and carbon monoxide, said method comprising:

a) pre-reforming a hydrocarbon mixture to obtain a first mixture;

b) reforming said first mixture with an oxidizing mixture to obtain a raw synthesis gas, wherein:

1) said oxidizing mixture comprises oxygen and is heated, prior to said reforming, to a temperature of about 1000° C;

2) said raw synthesis gas comprises:

i) hydrogen;

ii) carbon monoxide;

iii) carbon dioxide;

iv) water; and

v) an oxygen-depleted mixture; and

3) said reforming is performed in a catalytic ceramic membrane reactor (RCMC).

Claim 28 (cancelled):

Claim 29 (previously presented): The method of claim 27, wherein said first mixture is brought to a temperature, prior to said reforming, at least about 111° C lower than said temperature of said oxidizing mixture.

Claim 30 (previously presented): The method of 27, further comprising desulfurizing said hydrocarbon mixture prior to said pre-reforming.

Claim 31 (previously presented): The method of claim 30, wherein said hydrocarbon mixture is desulfurized at a temperature between about 250° C and about 450° C.

Claim 32 (previously presented): The method of claim 31, further comprising adding hydrogen to said hydrocarbon mixture prior to said desulfurization.

Claim 33 (previously presented): The method of claim 31, wherein said temperature of said hydrocarbon mixture is about 400° C.

Claim 34 (previously presented): The method of claim 27, wherein said pre-reforming is preformed in a catalytic reactor at a temperature between about 450° C and about 550° C;

Claim 35 (previously presented): The method of claim 34, wherein catalytic reactor is an adiabatic type catalytic reactor.

Claim 36 (previously presented): The method of 34, wherein said hydrocarbon mixture is preheated, prior to said pre-reforming, to a temperature of about 500° C.

Claim 37 (previously presented): The method of claim 27, wherein the temperature of said oxygen-depleted mixture is lower than said temperature of said oxidizing mixture.

Claim 38 (previously presented): The method of claim 37, wherein the difference between said temperature of said oxygen-depleted mixture and said temperature of said oxidizing mixture is at least about 75° C.

Claim 39 (previously presented): The method of claim 27, wherein the temperature of said first mixture is between about 550° C and about 670° C.

Claim 40 (previously presented): The method of claim 39, wherein said temperature of said first mixture is about 650° C.

Claim 41 (previously presented): The method of claim 27, wherein:

a) said raw synthesis gas is at a temperature between about 800° C and about 1100° C; and

b) the temperature of said oxygen-depleted mixture is lower than said temperature of said synthesis gas.

Claim 42 (previously presented): The method of claim 27, further comprising:

a) cooling said raw synthesis gas; and

b) separating said raw synthesis gas.

Claim 43 (previously presented): The method of claim 42, further comprising purifying said raw synthesis gas.

Claim 44 (previously presented): The method of claim 42, further comprising treating said raw synthesis gas.

Claim 45 (previously presented): The method of claim 27, wherein:

a) said oxidizing mixture is obtained through the treatment of a first oxygenated gas mixture; and

b) said first oxygenated gas mixture comprises between about 10 molar % and about 50 molar % of oxygen.

Claim 46 - 61 (cancelled):

Evidence Appendix

None.

Related Proceedings Appendix

None.